



flow PACK 0

600 V / 50 A

Features

- 2 clip housing in 12 mm and 17 mm height
- Trench Fieldstop IGBT³ technology
- Compact and low inductance design
- Built-in NTC

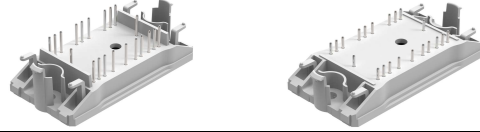
Target Applications

- Motor Drives
- Power Generation
- UPS

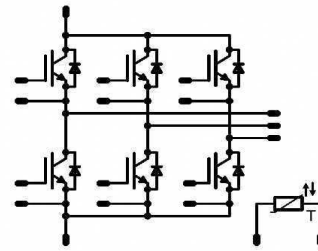
Types

- V23990-P865-F49-PM
- V23990-P865-F48-PM

flow 0 housing



Schematic



Maximum Ratings

$T_j = 25\text{ °C}$, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Inverter Transistor				
Collector-emitter voltage	V_{CE}		600	V
DC collector current	I_C	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	45	A
Repetitive peak collector current	I_{CRM}	t_p limited by T_{jmax}	150	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	76	W
Gate-emitter peak voltage	V_{GE}		±20	V
Short circuit ratings*	t_{SC} V_{CC}	$T_j \leq 150\text{ °C}$ $V_{GE} = 15\text{ V}$	6 360	µs V
Maximum Junction Temperature	T_{jmax}		175	°C

* It is recommended to not exceed 1000 short circuit situations in the lifetime of the module and to allow at least 1s between short circuits

Inverter Diode

Peak Repetitive Reverse Voltage	V_{RRM}		600	V
DC forward current	I_F	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	41	A
Repetitive peak forward current	I_{FRM}	t_p limited by T_{jmax}	100	A
Power dissipation	P_{tot}	$T_j = T_{jmax}$ $T_s = 80\text{ °C}$	57	W
Maximum Junction Temperature	T_{jmax}		175	°C

Thermal properties

Storage temperature	T_{stg}		-40.....+125	°C
Operation junction temperature	T_{op}		-40.....+ T_{jmax} -25	°C

**Maximum Ratings** $T_j = 25\text{ °C}$, unless otherwise specified

Parameter	Symbol	Condition	Value	Unit
Insulation properties				
Insulation voltage	V_{isol}	DC Test Voltage* $t_p = 2\text{ s}$	6000	V
		AC Voltage $t_p = 1\text{ min}$	2500	V
Creepage distance			min.12,7	mm
Clearance		12mm height	9,22	mm
		17mm height	min.12,7	mm
Comparative Tracking Index	CTI		>200	

*100% tested in production

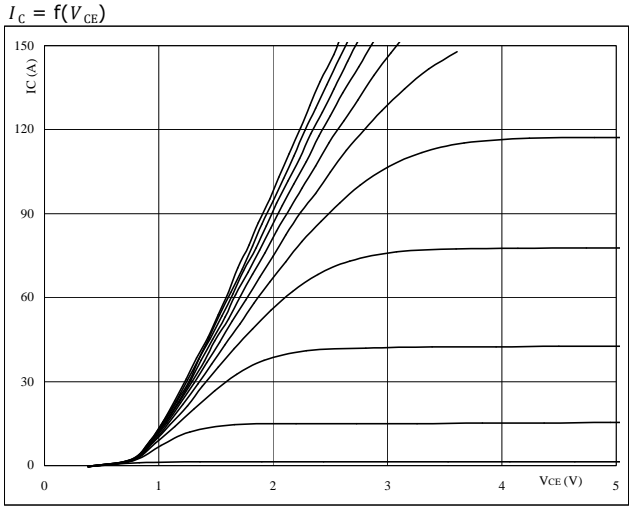
Characteristic Values

Parameter	Symbol	Conditions					Value			Unit
		V_{GS} [V]	V_{GE} [V]	V_{CE} [V]	I_C [A]	T_j [°C]	Min	Typ	Max	
Inverter Transistor										
Gate emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$			0,0008	25	5	5,8	6,5	V
Collector-emitter saturation voltage	V_{CESat}		15		50	25 150		1,51 1,75	2,1	V
Collector-emitter cut-off current incl. Diode	I_{CES}		0	600		25			350	μA
Gate-emitter leakage current	I_{GES}		20	0		25			650	nA
Integrated Gate resistor	R_{gint}							none		Ω
Turn-on delay time	$t_{d(on)}$	$R_{gon} = 8 \Omega$ $R_{goff} = 8 \Omega$	±15	300	50	25		95		ns
Rise time	t_r					150		100		
Turn-off delay time	$t_{d(off)}$					25		161		
Fall time	t_f					150		184		
Turn-on energy loss	E_{on}					25		109		
Turn-off energy loss	E_{off}					150		131		
Input capacitance	C_{ies}	$f = 1 \text{ MHz}$	0	25	25			3140		pF
Output capacitance	C_{oss}							200		
Reverse transfer capacitance	C_{rss}							93		
Gate charge	Q_G		15	300	50	25		310		nC
Thermal resistance chip to heatsink	$R_{th(j-s)}$	$\lambda_{paste} = 0,8 \text{ W/mK}$ (P12)						1,25		K/W
Inverter Diode										
Diode forward voltage	V_F				50	25 150		1,6 1,55	2,2	V
Peak reverse recovery current	I_{RRM}	$R_{gon} = 8 \Omega$	±15	300	50	25		51,6		A
Reverse recovery time	t_{rr}					150		62,4		
Reverse recovered charge	Q_{rr}					25		130		
Peak rate of fall of recovery current	$(di_{rr}/dt)_{max}$					150		172		
Reverse recovered energy	E_{rec}					25		2,29		
Thermal resistance chip to heatsink	$R_{th(j-s)}$					150		4,37		
				3909				0,92		mWs
				2375						A/ms
										mWs
										K/W
										K/W
Thermistor										
Rated resistance	R					25		22		kΩ
Deviation of R_{100}	$\Delta_{R/R}$	$R_{100} = 1486 \Omega$				100	-5		+5	%
Power dissipation	P					25		210		mW
Power dissipation constant						25		4,4		mW/K
B-value	$B_{(25/50)}$	Tol. -13,1%				25		3940		K
B-value	$B_{(25/100)}$	Tol. +11,6%				25		4000		K
Vincotech NTC Reference									A	



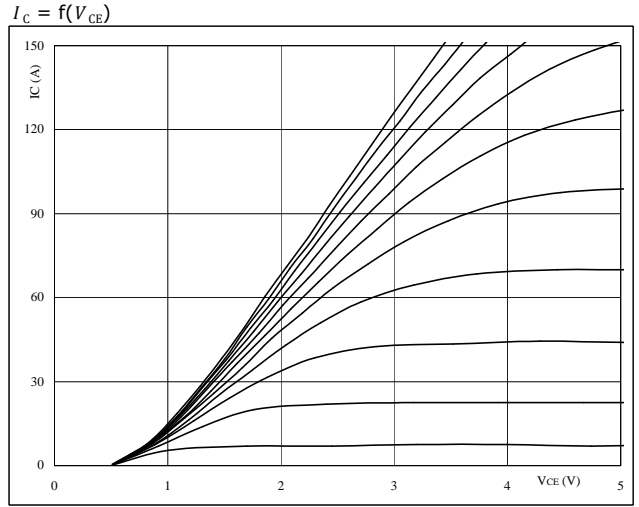
Output Inverter

figure 1 IGBT
Typical output characteristics



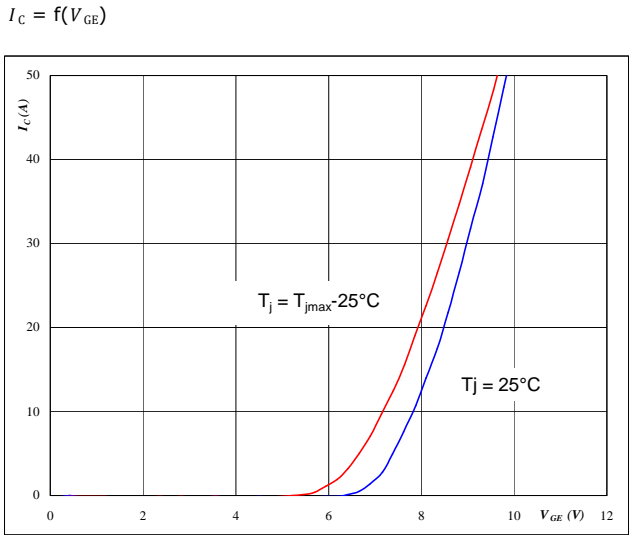
$t_p = 250 \mu s$
 $T_j = 25 \text{ }^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

figure 2 IGBT
Typical output characteristics



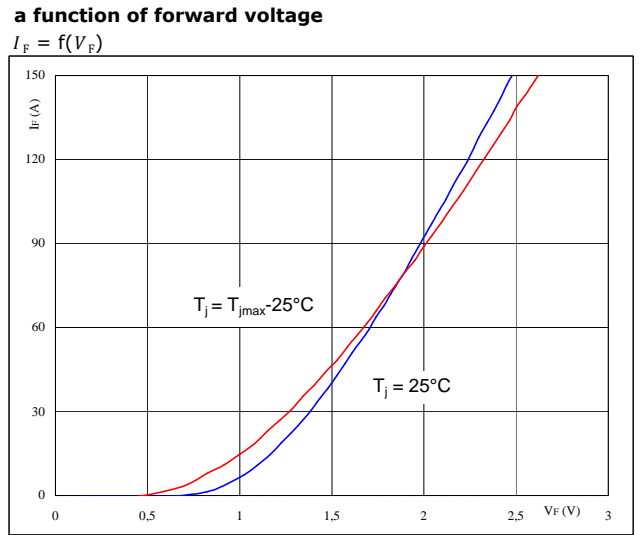
$t_p = 250 \mu s$
 $T_j = 150 \text{ }^\circ C$
 V_{GE} from 7 V to 17 V in steps of 1 V

figure 3 IGBT
Typical transfer characteristics



$t_p = 250 \mu s$
 $V_{CE} = 10 V$

figure 4 FWD
Typical diode forward current as a function of forward voltage



$t_p = 250 \mu s$

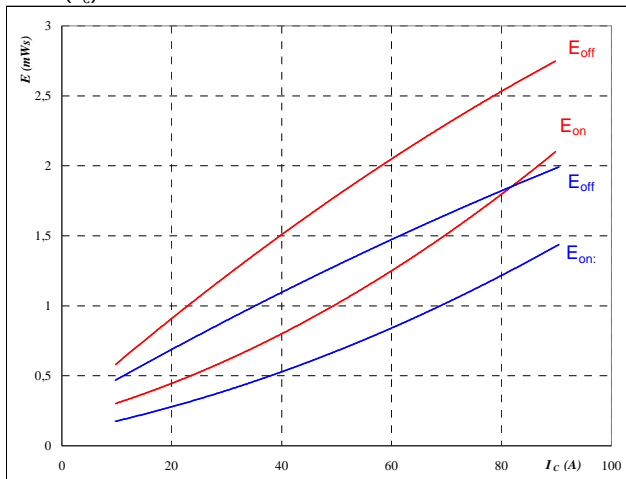


Output Inverter

figure 5 IGBT

Typical switching energy losses
as a function of collector current

$E = f(I_C)$



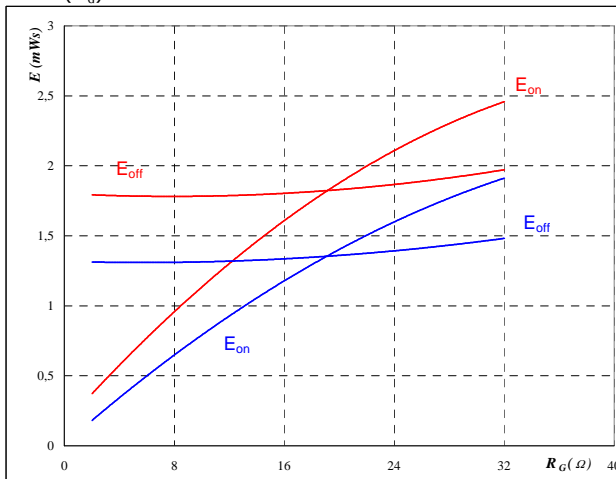
inductive load

- Tj = 25/150 °C
- VCE = 300 V
- VGE = ±15 V
- Rgon = 8 Ω
- Rgoff = 8 Ω

figure 6 IGBT

Typical switching energy losses
as a function of gate resistor

$E = f(R_G)$



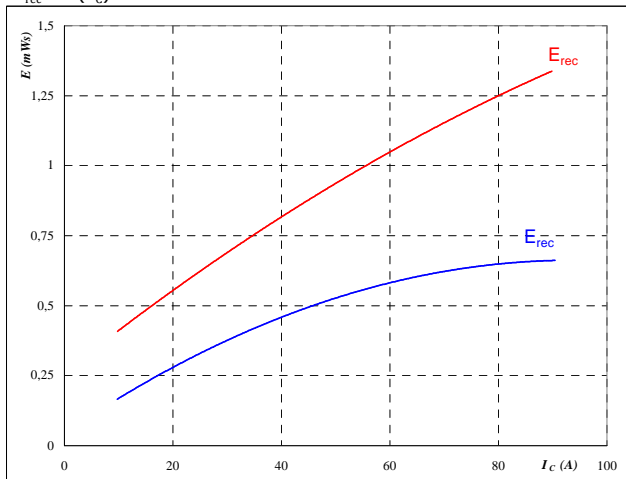
inductive load

- Tj = 25/150 °C
- VCE = 300 V
- VGE = ±15 V
- Ic = 50 A

figure 7 IGBT

Typical reverse recovery energy loss
as a function of collector current

$E_{rec} = f(I_C)$



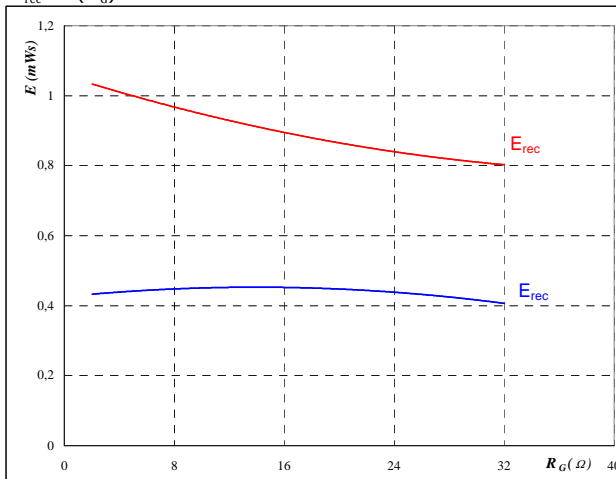
inductive load

- Tj = 25/150 °C
- VCE = 300 V
- VGE = ±15 V
- Rgon = 8 Ω

figure 8 IGBT

Typical reverse recovery energy loss
as a function of gate resistor

$E_{rec} = f(R_G)$



inductive load

- Tj = 25/150 °C
- VCE = 300 V
- VGE = ±15 V
- Ic = 50 A

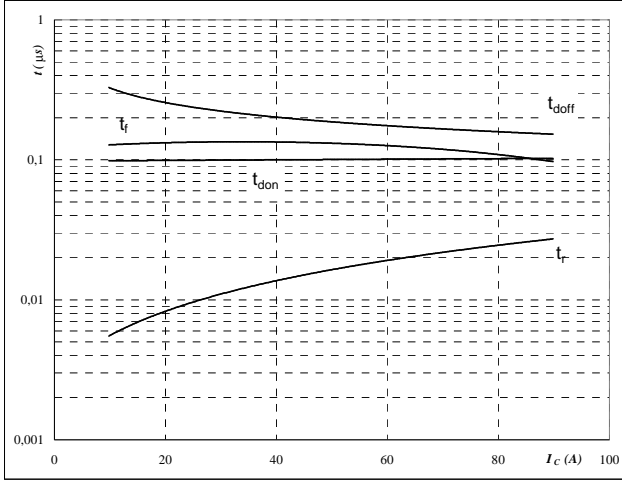


Output Inverter

figure 9 IGBT

Typical switching times as a function of collector current

$$t = f(I_C)$$



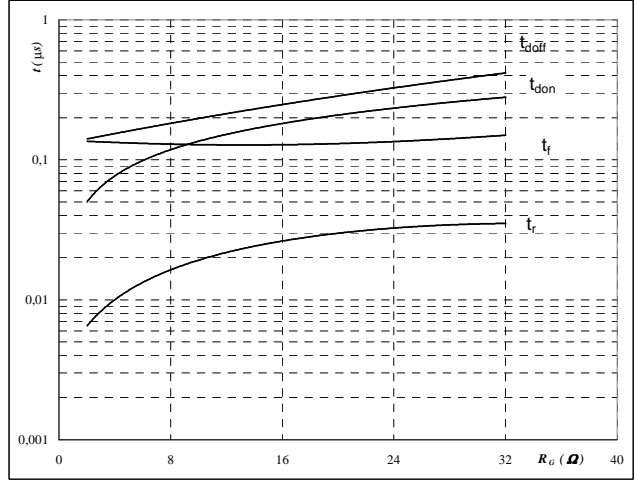
inductive load

$T_j =$	150	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$R_{gon} =$	8	Ω
$R_{goff} =$	8	Ω

figure 10 IGBT

Typical switching times as a function of gate resistor

$$t = f(R_G)$$



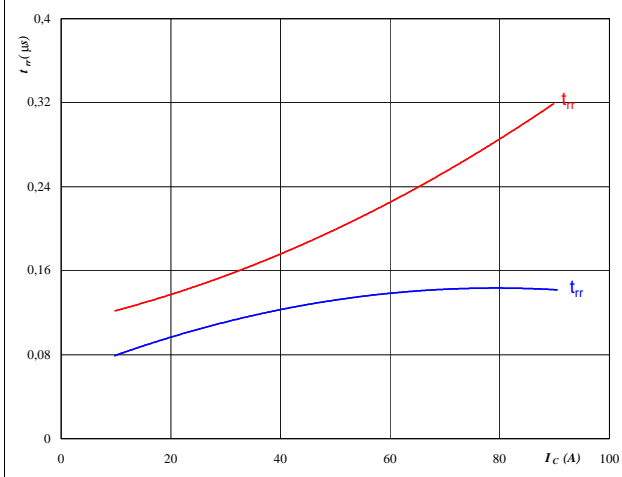
inductive load

$T_j =$	150	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$I_C =$	50	A

figure 11 FWD

Typical reverse recovery time as a function of collector current

$$t_{rr} = f(I_C)$$

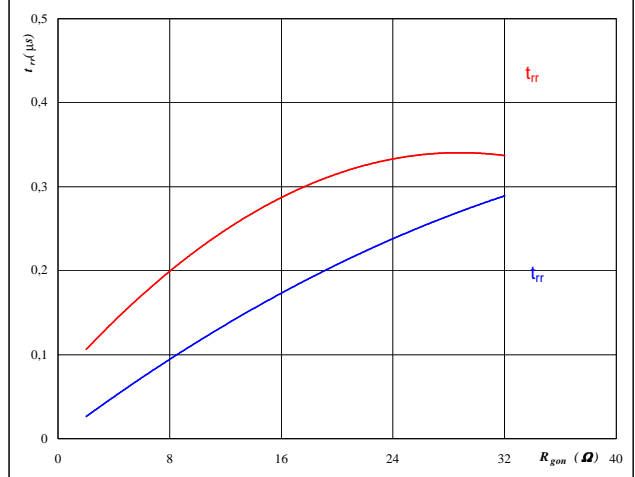


$T_j =$	25/150	°C
$V_{CE} =$	300	V
$V_{GE} =$	±15	V
$R_{gon} =$	8	Ω

figure 12 FWD

Typical reverse recovery time as a function of IGBT turn on gate resistor

$$t_{rr} = f(R_{gon})$$



$T_j =$	25/150	°C
$V_R =$	300	V
$I_F =$	50	A
$V_{GE} =$	±15	V

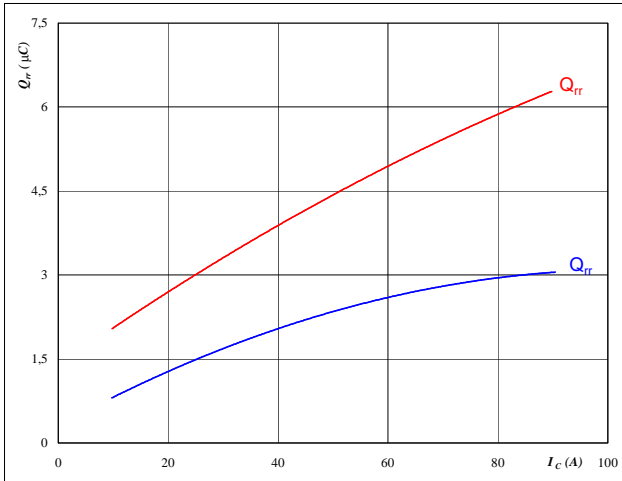


Output Inverter

figure 13 FWD

Typical reverse recovery charge as a function of collector current

$Q_{rr} = f(I_C)$

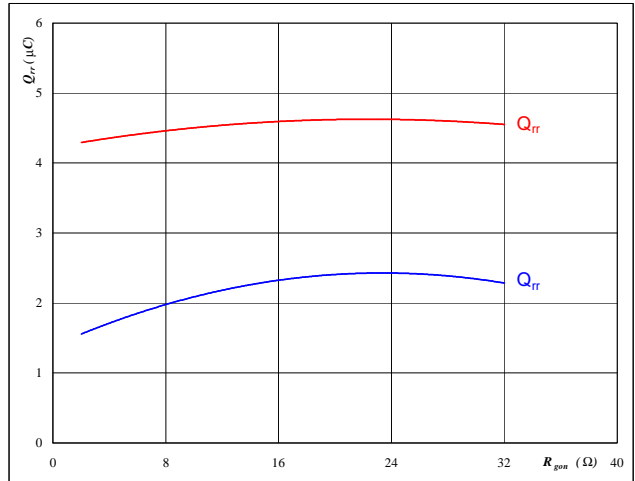


$T_j = 25/150$ °C
 $V_{CE} = 300$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 8$ Ω

figure 14 FWD

Typical reverse recovery charge as a function of IGBT turn on gate resistor

$Q_{rr} = f(R_{gon})$

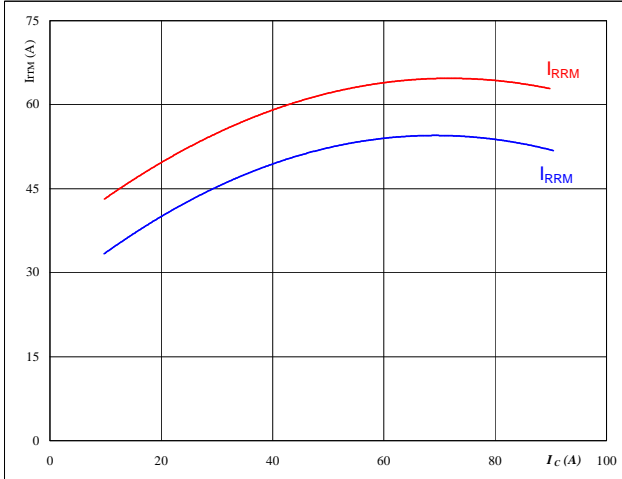


$T_j = 25/150$ °C
 $V_R = 300$ V
 $I_F = 50$ A
 $V_{GE} = \pm 15$ V

figure 15 FWD

Typical reverse recovery current as a function of collector current

$I_{RRM} = f(I_C)$

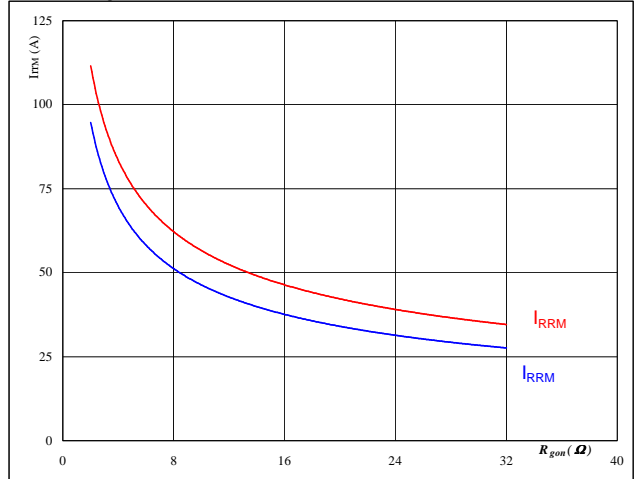


$T_j = 25/150$ °C
 $V_{CE} = 300$ V
 $V_{GE} = \pm 15$ V
 $R_{gon} = 8$ Ω

figure 16 FWD

Typical reverse recovery current as a function of IGBT turn on gate resistor

$I_{RRM} = f(R_{gon})$



$T_j = 25/150$ °C
 $V_R = 300$ V
 $I_F = 50$ A
 $V_{GE} = \pm 15$ V

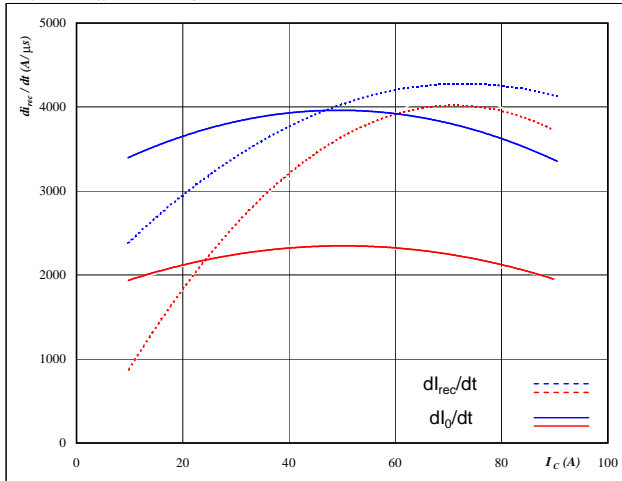


Output Inverter

figure 17 FWD

Typical rate of fall of forward and reverse recovery current as a function of collector current

$$dI_0/dt, dI_{rec}/dt = f(I_C)$$

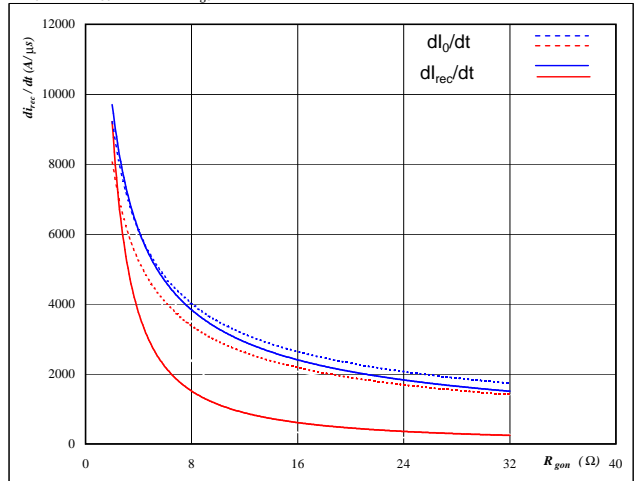


$T_j = 25/150 \text{ } ^\circ\text{C}$
 $V_{CE} = 300 \text{ V}$
 $V_{GE} = \pm 15 \text{ V}$
 $R_{gon} = 8 \text{ } \Omega$

figure 18 FWD

Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor

$$dI_0/dt, dI_{rec}/dt = f(R_{gon})$$

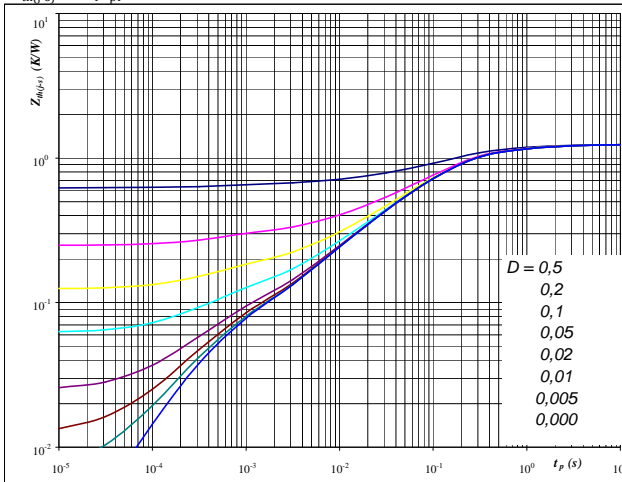


$T_j = 25/150 \text{ } ^\circ\text{C}$
 $V_R = 300 \text{ V}$
 $I_F = 50 \text{ A}$
 $V_{GE} = \pm 15 \text{ V}$

figure 19 IGBT

IGBT transient thermal impedance as a function of pulse width

$$Z_{th(f-s)} = f(t_p)$$



$D = t_p / T$
 $R_{th(f-s)} = 1,25 \text{ K/W}$

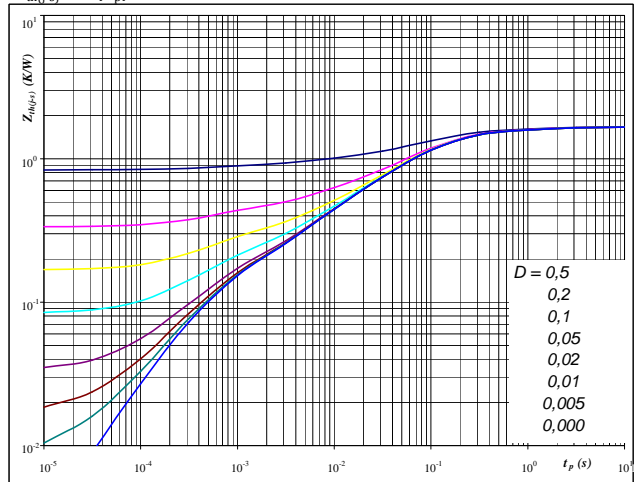
IGBT thermal model values

R (K/W)	Tau (s)
2,46E-02	9,85E+00
1,58E-01	1,06E+00
6,51E-01	1,57E-01
2,59E-01	3,32E-02
9,42E-02	6,06E-03
5,79E-02	4,45E-04

figure 20 FWD

FWD transient thermal impedance as a function of pulse width

$$Z_{th(f-s)} = f(t_p)$$



$D = t_p / T$
 $R_{th(f-s)} = 1,67 \text{ K/W}$

FWD thermal model values

R (K/W)	Tau (s)
2,55E-02	9,77E+00
1,59E-01	9,92E-01
6,81E-01	1,32E-01
5,00E-01	3,66E-02
1,83E-01	5,78E-03
1,22E-01	5,07E-04

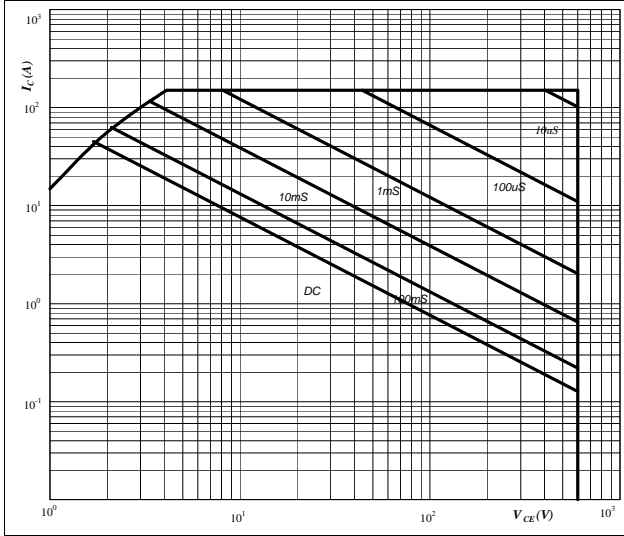


Output Inverter

figure 21 IGBT

Safe operating area as a function of collector-emitter voltage

$I_C = f(V_{CE})$

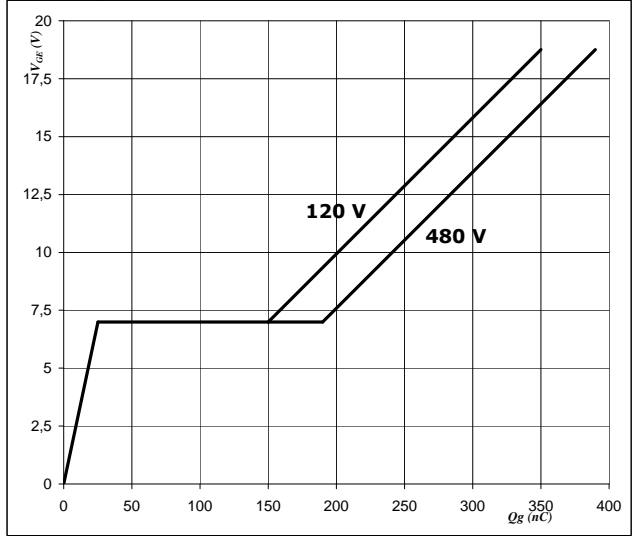


$D =$ single pulse
 $T_s =$ 80 °C
 $V_{GE} =$ ±15 V
 $T_j = T_{jmax}$

figure 22 IGBT

Gate voltage vs Gate charge

$V_{GE} = f(Q_g)$



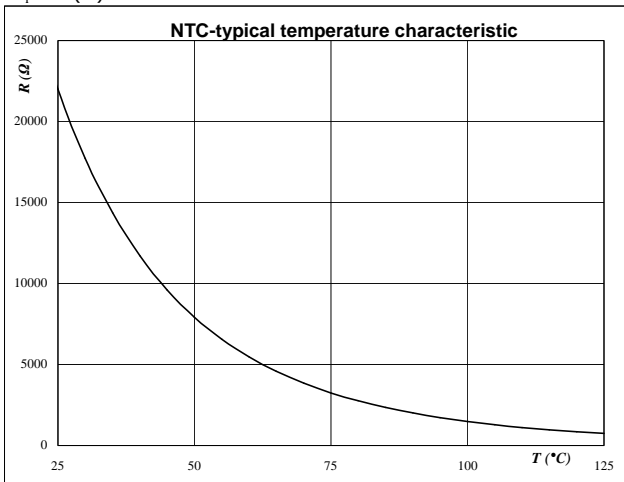
$I_C =$ 50 A

Thermistor

figure 1 Thermistor

Typical NTC characteristic as a function of temperature

$R_T = f(T)$





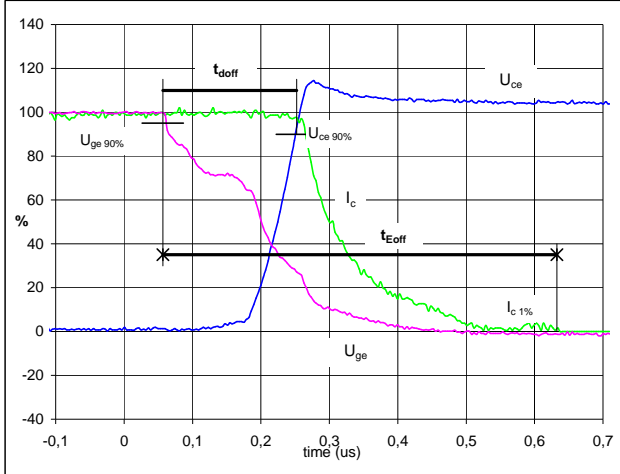
Switching Definitions Output Inverter

General conditions

T_j	=	150 °C
R_{gon}	=	8 Ω
R_{goff}	=	8 Ω

Figure 1 IGBT

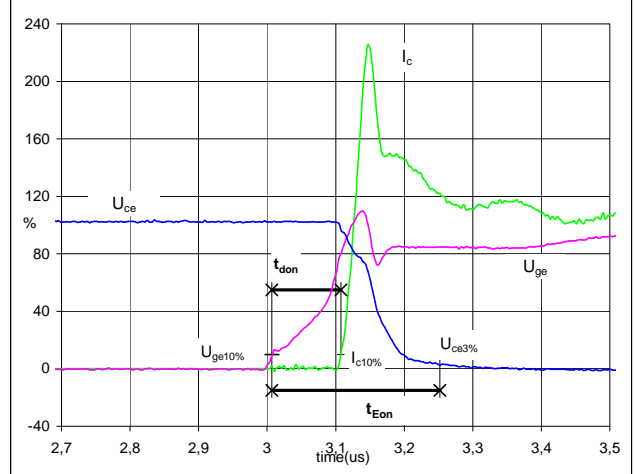
Turn-off Switching Waveforms & definition of t_{doff} , t_{Eoff}
(t_{Eoff} = integrating time for E_{off})



$V_{GE} (0\%) =$	-15	V
$V_{GE} (100\%) =$	15	V
$V_C (100\%) =$	300	V
$I_C (100\%) =$	50	A
$t_{doff} =$	0,18	μ s
$t_{Eoff} =$	0,58	μ s

Figure 2 IGBT

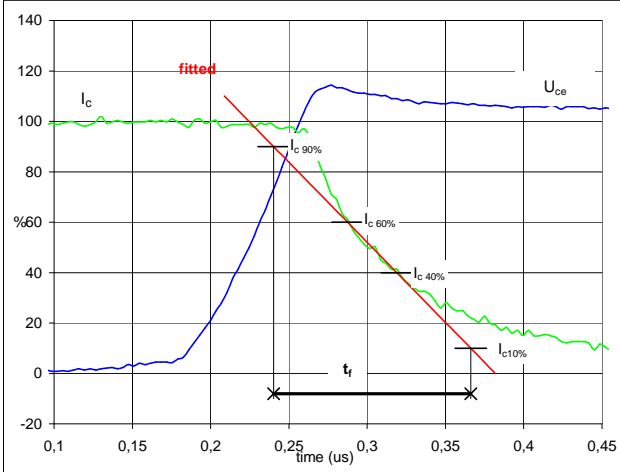
Turn-on Switching Waveforms & definition of t_{don} , t_{Eon}
(t_{Eon} = integrating time for E_{on})



$V_{GE} (0\%) =$	-15	V
$V_{GE} (100\%) =$	15	V
$V_C (100\%) =$	300	V
$I_C (100\%) =$	50	A
$t_{don} =$	0,10	μ s
$t_{Eon} =$	0,24	μ s

Figure 3 IGBT

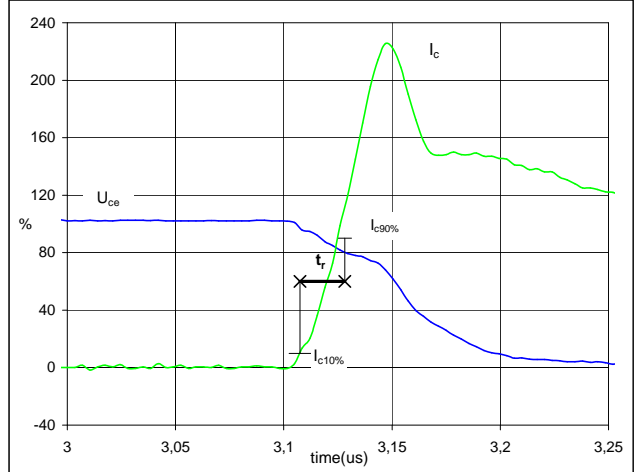
Turn-off Switching Waveforms & definition of t_f



$V_C (100\%) =$	300	V
$I_C (100\%) =$	50	A
$t_f =$	0,13	μ s

Figure 4 IGBT

Turn-on Switching Waveforms & definition of t_r

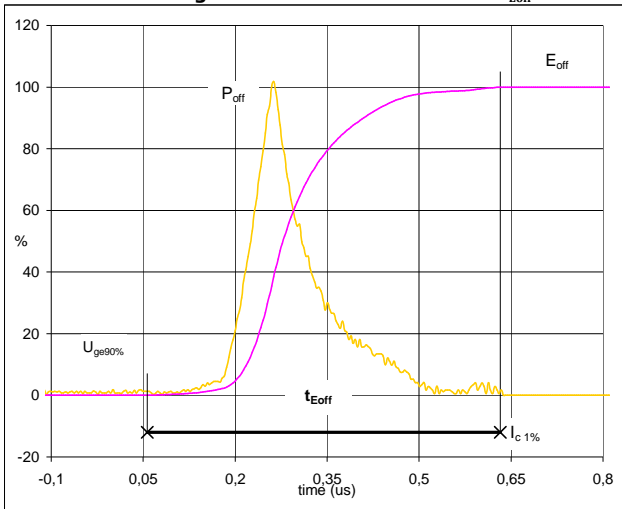


$V_C (100\%) =$	300	V
$I_C (100\%) =$	50	A
$t_r =$	0,02	μ s



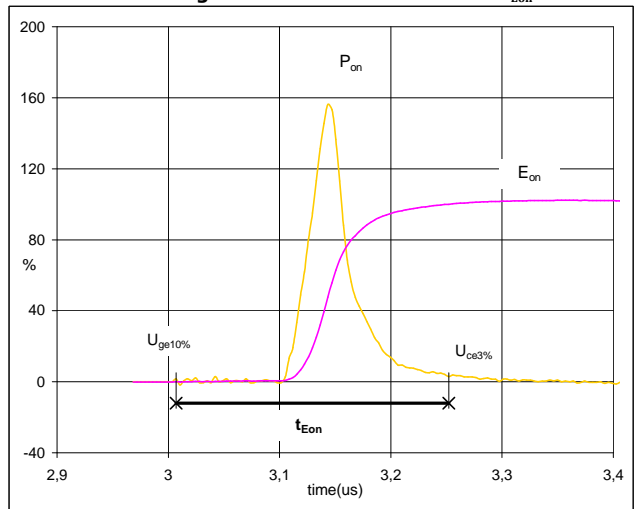
Switching Definitions Output Inverter

Figure 5 IGBT
Turn-off Switching Waveforms & definition of t_{Eoff}



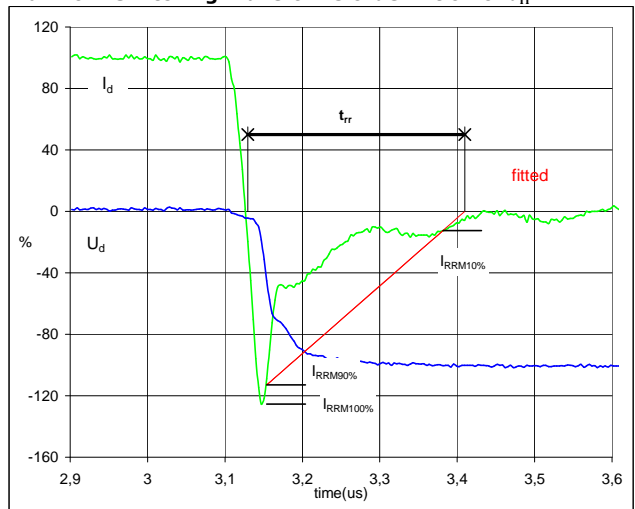
$P_{off} (100\%) = 15,02 \text{ kW}$
 $E_{off} (100\%) = 1,76 \text{ mJ}$
 $t_{Eoff} = 0,58 \text{ } \mu\text{s}$

Figure 6 IGBT
Turn-on Switching Waveforms & definition of t_{Eon}



$P_{on} (100\%) = 15,02 \text{ kW}$
 $E_{on} (100\%) = 1,02 \text{ mJ}$
 $t_{Eon} = 0,24 \text{ } \mu\text{s}$

Figure 7 FWD
Turn-off Switching Waveforms & definition of t_{rr}



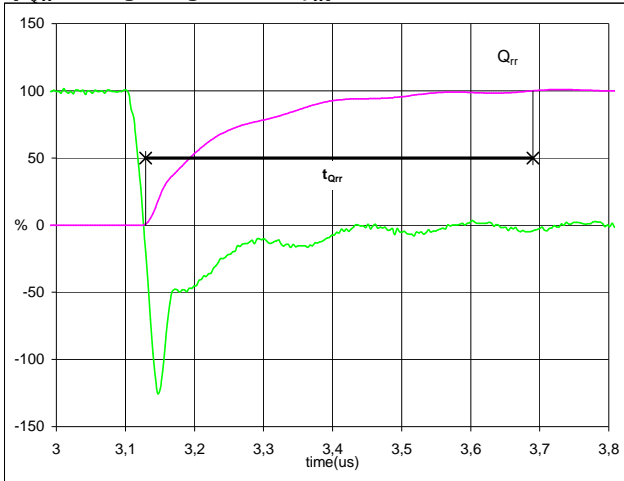
$V_d (100\%) = 300 \text{ V}$
 $I_d (100\%) = 50 \text{ A}$
 $I_{RRM} (100\%) = -62 \text{ A}$
 $t_{rr} = 0,17 \text{ } \mu\text{s}$



Switching Definitions Output Inverter

Figure 8 FWD

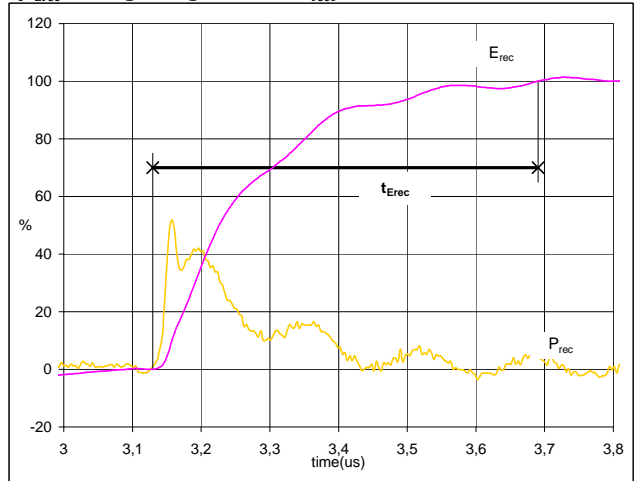
Turn-on Switching Waveforms & definition of t_{Qrr}
(t_{Qrr} = integrating time for Q_{rr})



I_d (100%) =	50	A
Q_{rr} (100%) =	4,37	μC
t_{Qrr} =	0,56	μs

Figure 9 FWD

Turn-on Switching Waveforms & definition of t_{Erec}
(t_{Erec} = integrating time for E_{rec})



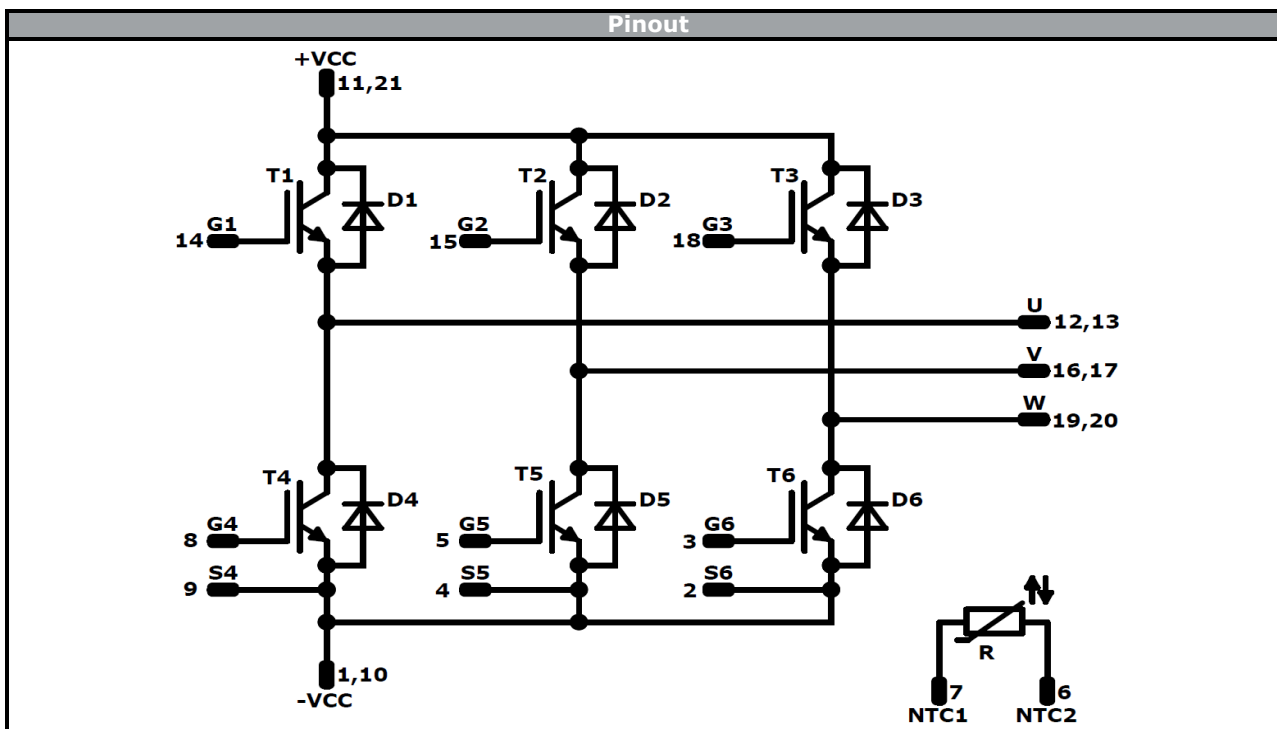
P_{rec} (100%) =	15,02	kW
E_{rec} (100%) =	0,92	mJ
t_{Erec} =	0,56	μs



Ordering Code & Marking							
Version			Ordering Code				
without thermal paste 12 mm housing			V23990-P865-F48-PM				
without thermal paste 17 mm housing			V23990-P865-F49-PM				
	Text	VIN	Date code	Name&Ver	UL	Lot	Serial
		VIN	WWYY	NNNNVVV	UL	LLLLL	SSSS
	Datamatrix	Type&Ver	Lot number	Serial	Date code		
		TTTTTTVV	LLLLL	SSSS	WWYY		

Pin table [mm]				Outline	
Pin	X	Y	Function		
1	33,3	0	-Vcc		17 mm housing
2	30,7	0	S6		
3	27,9	0	G6		
4	23,85	0	S5		
5	21,05	0	G5		
6	15,95	0	NTC2		
7	9,6	0	NTC1		12 mm housing
8	5,4	0	G4		
9	2,6	0	S4		
10	0	0	-Vcc		
11	0	11,15	+Vcc		
12	0	22,3	U		
13	2,6	22,3	U		
14	5,5	22,3	G1		
15	13,1	22,3	G2		
16	15,9	22,3	V		
17	19,4	22,3	V		
18	27,7	22,3	G3		
19	30,7	22,3	W		
20	33,3	22,3	W		
21	33,3	11,15	+Vcc		

Tolerance of pinpositions: ±0.5mm at the end of pins
Dimension of coordinate axis is only offset without tolerance



Identification					
ID	Component	Voltage	Current	Function	Comment
T1, T2, T3, T4, T5, T6	IGBT	600 V	50 A	Inverter Transistor	
D1, D2, D3, D4, D5, D6	FWD	600 V	50 A	Inverter Diode	
R	NTC			Thermistor	

**Packaging instruction**

Standard packaging quantity (SPQ)	135	>SPQ	Standard	<SPQ	Sample
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Handling instruction

Handling instructions for *flow* 0 packages see vincotech.com website.

Package data

Package data for *flow* 0 packages see vincotech.com website.

UL recognition and file number

This device is certified according to UL 1557 standard, UL file number E192116. For more information see vincotech.com website.



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